U.S. Department of Transportation
Federal Highway Administration

Memorandum

Subject: **INFORMATION**: Conformity and Nitrogen Oxides (NOx)

Date: MAR 10 1994

From: Director, Office of Environment and Planning
Director, Office of Planning

Reply to Attn. of: HEP-40

To: Directors, FHWA Office of Planning and Program Development (Regions 1-7 and 10)
Directors, FHWA Office of Program Development (Regions 8 and 9)
Directors, FTA Office of Program Development (Regions 1-10)

Since issuance of the final rule on transportation conformity in November 1993, reductions in NOx have become a significant issue for many ozone nonattainment areas. We are working with several areas and with the Environmental Protection Agency to explore solutions that contribute to NOx reductions and enable transportation plans, programs, and projects to proceed. In this memo, we want to provide you with an interim report on the situation and potential solutions. Attached to this memo are:

1) Background Data on NOx;

2) Transportation Options to Reduce NOx Emissions;

3) Travel Demand Modelling Considerations on NOx Emissions;

4) Current NOx-Related Conformity Issues;

5) NOx Waivers and Other EPA Actions Affecting NOx Conformity; and

6) List of DOT Contacts for more Information on Particular Aspects of NOx.

We are continuing to provide NOx technical assistance to several areas, both to assist them and to enable us to develop recommendations and strategies for general use. As we learn more

about NOx, we will provide more information to you. In the meantime, please contact us or one of the individuals listed on Attachment 6 for further information or to let us know of any useful insights or experiences in your region.

Samuel L. Zimmerman

Kevin E. Heanue

6 Attachments

cc: Jane Garvey
Tony Kane
Ed Kussy
Reid Alsop
Abbe Marner, FTA
Camille Mittelholtz, OST
Phil Lorang, EPA
Paula Van Lare, EPA
Jon Kessler, EPA
Dave Clawson, AASHTO
Janet Oakley, NARC
Nancy Krueger, STAPPA/ALAPCO
Rich Weaver, APTA
Becky Brady, NCSL
Lydia Conrad, NGA
Joan Glickman, ICMA
Robert Fogel, NACO
Cara Woodsen, NLC
Kevin McCarthy, USCM
Leo Penne, Nevada Office
Mike McGarry, Ohio Office

ATTACHMENT 1

BACKGROUND DATA ON TRANSPORTATION NO_x EMISSIONS

Overall NO_x Emission Trends

Highway vehicles account for 32% of the 1992 nationwide anthropogenic NO_x emissions[1] (see Figure 1). On a nationwide basis, NO_x emission reductions from highway vehicles have decreased, but they have been offset by increased emissions from stationary sources (see Figure 2). Transportation-related NO_x emission reductions have been primarily obtained in urban areas while the stationary source emission increases are more uniformly distributed between urban and rural areas.

Vehicle Fleet NO_x Emission Factors (based on EPA MOBILE5 model)

NO_x emissions vary significantly with speed; also, heavy duty diesel trucks are much larger sources of NO_x than other vehicles based on a vehicle-by-vehicle comparison. Figure 3 shows a typical fleet-averaged NO_x emission factor speed curve. Separate curves are also shown for light duty gasoline vehicle (car) emission factors and heavy duty diesel truck emission factors. The heavy duty diesel vehicle fraction, which represents 6.1% of the vehicle fleet VMT (MOBILE5a default value), is responsible for about 40-50% of the vehicle NO_x emissions. Speed curves for both diesel trucks (Figure 3) and cars (enlargement shown in Figure 4) are characterized by a U-shaped curve.

Regarding the speed curve for cars, Figure 4, the emission factor decreases with increasing average speed in the low-speed range (below 15 MPH). Thus, at constant VMT, speed improvement measures in extremely congested areas may yield NO_x emission decreases. The speed curve exhibits a minimum at about 15-20 MPH and the emission factors gradually increase with increasing average speed in the mid-speed range. For constant VMT, speed flow improvements in this range generally reduce VOC emissions but increase NO_x emissions. Note that the MOBILE5-series models predict a positive NO_x emissions slope in the mid-speed range while the MOBILE4-series models predicted a negative slope (emissions decrease with increasing average speed) in this range. According to the MOBILE5 model, NO_x emissions increase sharply with increased average speed in the high-speed range (greater than 45-50 MPH). The overall impact of transportation projects on NO_x emissions will depend on the project-induced changes in the VMT distribution among the various speed increments.

---

[1]Off-highway mobile sources contribute 13% of the nationwide NO_x emissions. Trains and off-road diesels (e.g. construction equipment) dominate the emissions from this source category.

Impact of Transportation Projects on Overall NO_x Emissions

Figure 5 shows the NO_x emissions estimated for various analysis years of the Washington, D.C. FY 94 conformity analysis. Over time, significant NO_x reductions are predicted relative to the 1990 base year emissions. Each analysis year would, however, fail the build/nobuild test because the build scenario emissions exceed the nobuild scenario emissions. We have also analyzed FY 94 TIPs and plans from Ohio and observed similar trends. For the few cases we have studied, emission increases for the build scenario are small compared to the overall NO_x emission reductions, yet a conformity determination cannot be made.

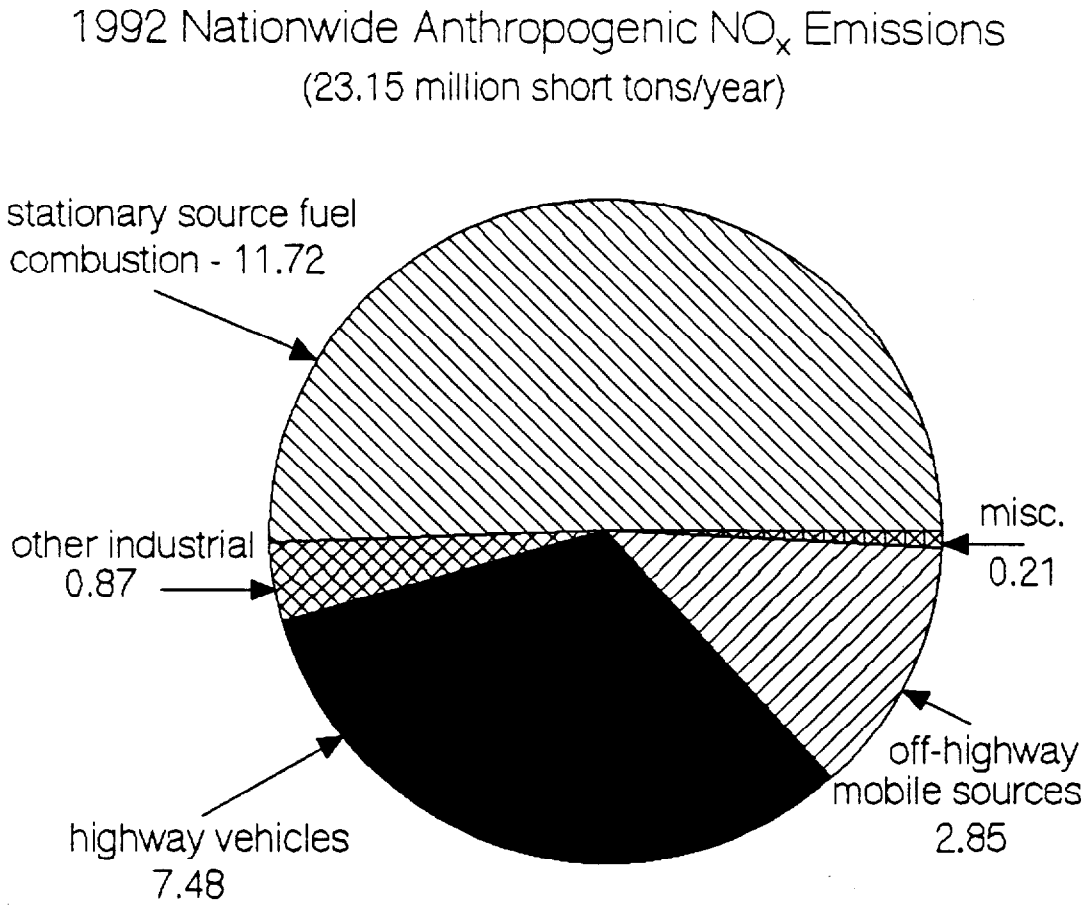


Figure 1. 1992 annual nationwide NO_x emissions in million short tons per year. One short ton = 2000 pounds. Data from: National Air Quality and Emissions Trends Report, 1992, EPA-454/R-93-031, U.S. EPA, October 1993.

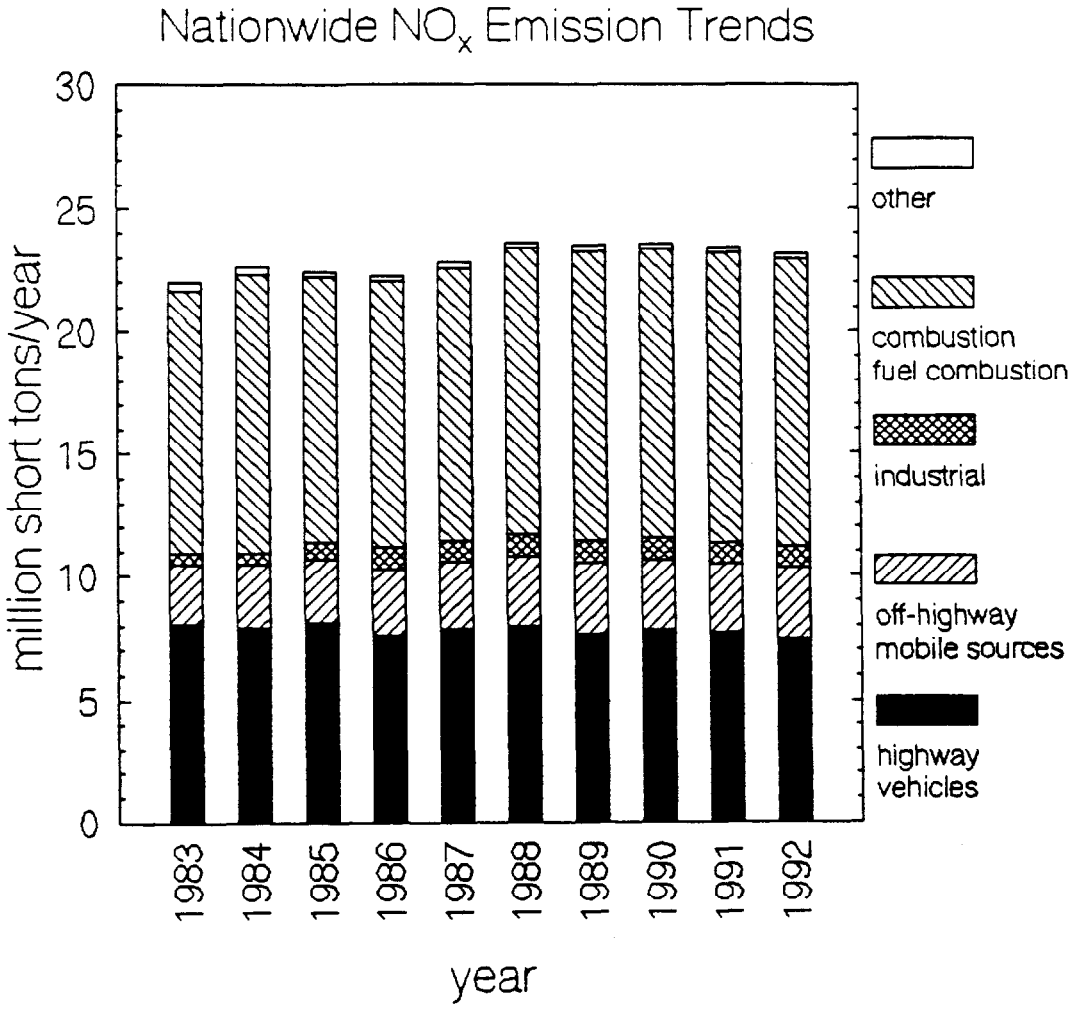


Figure 2. Annual nationwide NO_x emissions for 1983-1992 in million metric tons per year. One short ton = 2000 pounds. Data from: National Air Quality and Emissions Trends Report, 1992, EPA-343/R-93-031, U.S. EPA, October 1993.

NOx Emission Factors vs. Speed

(Year = 1995, Temp = 87.5F, Low Altitude)

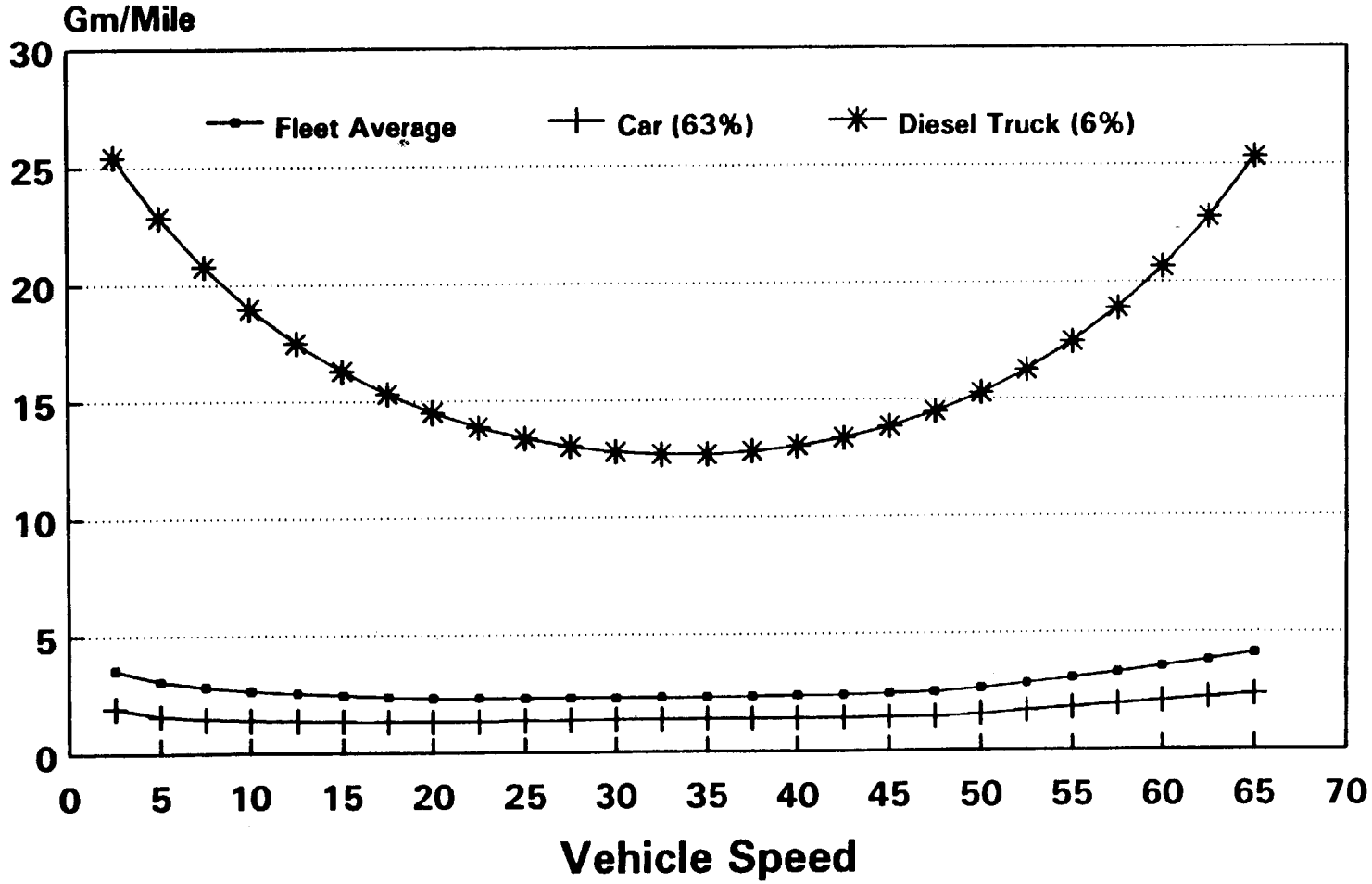


Figure 3. Speed curves for NO_x emission factors. Top curve - heavy duty diesel truck; middle curve - fleet averaged emission factor; and bottom curve - light duty passenger vehicle.

NOx Emission Factors vs. Speed

(Year = 1995, Temp = 87.5F, Low Altitude)

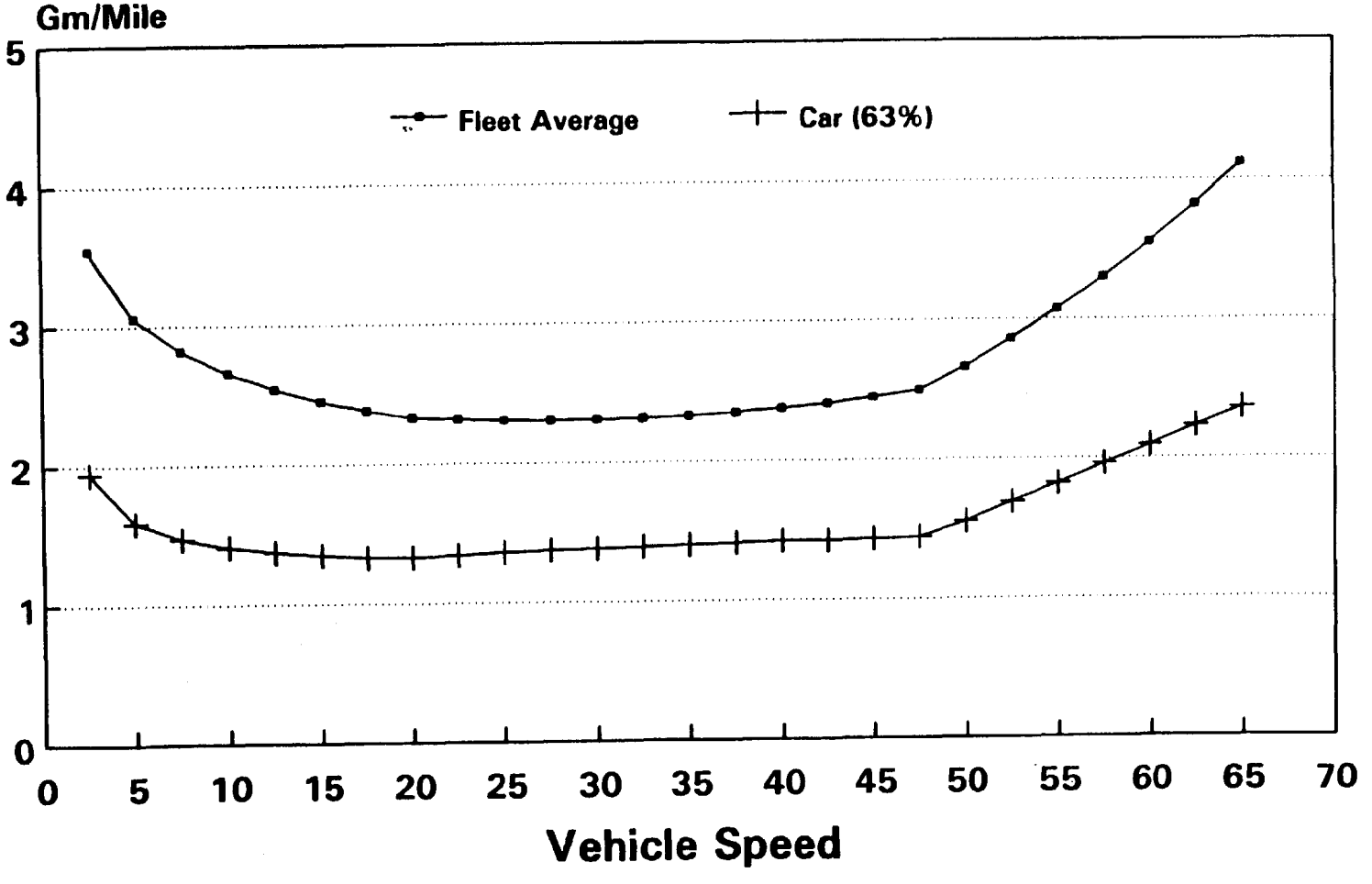


Figure 4. Speed curves for NO_x emission factors (enlargement of bottom two curves of Figure 3). Top curve - fleet averaged emission factor; and bottom curve - light duty passenger vehicle.

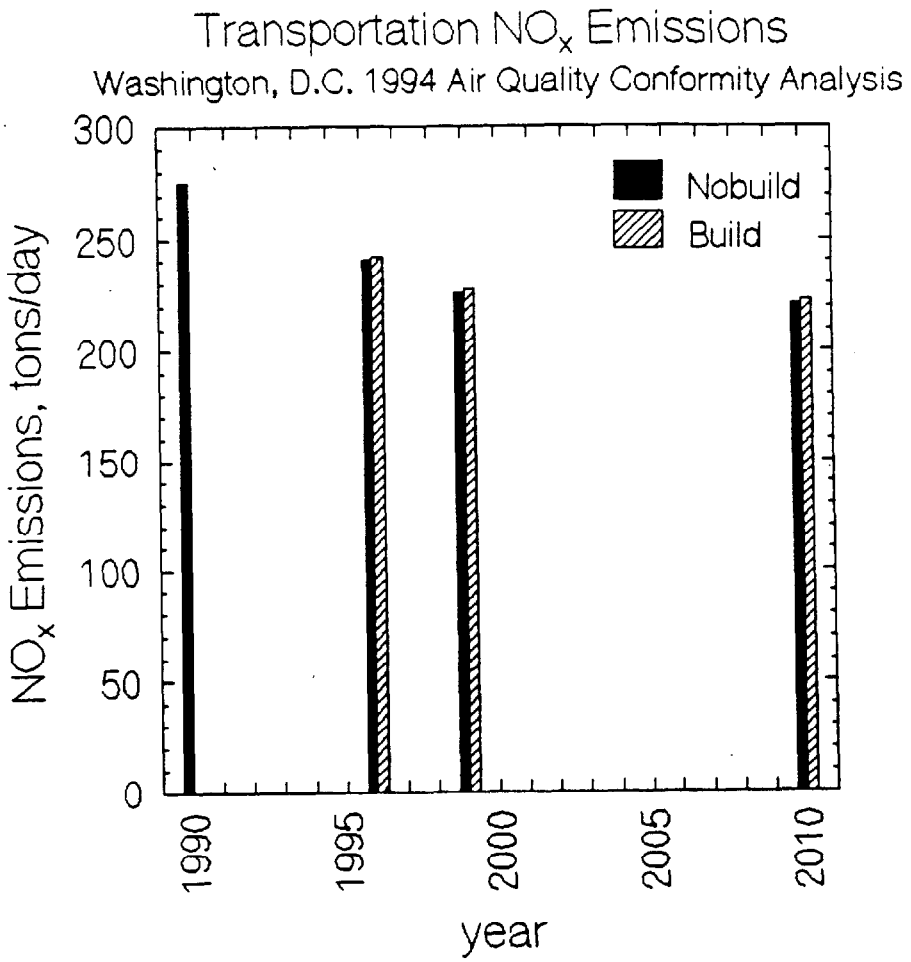


Figure 5. Trip cycle NO_x emissions by year and scenario for Washington, D.C. FY 1994 conformity analysis. Data from: Metropolitan D.C. Case Study, FHWA/TSC, in preparation.

TRANSPORTATION OPTIONS TO REDUCE NO_x EMISSIONS

The greatest strides in reducing transportation NO_x emissions will continue to arise from new vehicle technology developments, enhanced vehicle inspection and maintenance, and reformulated gasoline. However, these measures must be credited to both the "build" and "nobuild" scenario". Possible measures to reduce NO_x emissions which can be credited to solely the "build" option include the following.

- VMT Reductions: Travel demand management (TDM) strategies which reduce growth in VMT will often reduce NO_x emissions. TDM's in the "build" option that reduce VMT growth, even by very small amounts over the "no-build" option, should be considered and included in the NO_x analysis. **"Off model" calculations are permissible in order to capture small effects that otherwise would not surface in the model runs.** Because NO_x emissions are speed dependent, it is important to consider the redistribution of VMT among speed increments when assessing the impact of demand management strategies on NO_x emissions. TDM's that reduce VMT growth in higher-speed travel (above 45 MPH) are particularly helpful in reducing NO_x.

- Transit Improvements: Public transit can be powerful tools to reduce VMT as well as vehicle trips. Examples include expanded transit service, lower fares, and innovative types of service. Transit improvements, by offering an equal or even better mobility alternative to the single-occupancy-vehicle (SOV), could be the necessary 'quid pro quo' to make politically palatable the various programs which discourage SOV use.

- Congestion Mitigation Measures: Speed improvements may increase or decrease NO_x emissions depending on the scenario (see Attachment "Background Data on Transportation NO_x Emissions"). NO_x emissions may decrease when measures such as signalization improvements are used in extremely congested areas.

- Speed Limit Enforcement: NO_x emissions increase dramatically with increasing speed above about 45-50 MPH. Speed limit enforcement can reduce NO_x emissions by redistributing VMT to lower speed increments.

- Older Vehicle Elimination: Motor vehicle NO_x controls were not introduced until the mid-1970s. The retirement of older vehicles will lower NO_x emissions because the retired VMT will be replaced with VMT from cleaner vehicles. Vehicle elimination in general may not be applied solely to the "build" scenario in performing a conformity analysis. However, FHWA will discuss with EPA the possibility to

credit solely to the "build" option those vehicle retirement programs (such as a cash for clunkers program or the replacement of older transit vehicles with cleaner ones) which are implemented specifically to mitigate emissions from transportation projects. In this case, we propose that the program be credited solely to the "build" scenario if the program sponsor commits to implementation of the program.

- Diesel Engine Restrictions: Heavy duty diesel engines (including truck and bus fleets) represent a disproportionate share of the motor vehicle NO_x emissions (see Attachment "Background Data on Transportation NO_x Emissions"). NO_x reductions could be achieved through fleet replacement with cleaner vehicles. This option would apply to those fleet replacement programs that are funded with Title 23 resources, Transit Act Funds, or if the program sponsor commits to a replacement strategy as part of the "build" scenario.

The effectiveness of these measures will vary greatly by area, depending on the area's ozone characteristics and the particular form of NO_x control strategy selected. Once any measures are used in a conformity analysis for a particular plan or TIP, they would become part of both the "build" and "no-build" scenarios in the next analysis. This means new measures would have to be added to future plans and TIPs to satisfy the NO_x conformity test.

Attachment 3

Travel Demand Modelling Considerations on NOx Emissions

The following are preliminary recommendations. Research is currently underway to provide additional insight into the modelling effects on NOx emissions.

1. Include all measures in the analytic process which will alter Single Occupant Vehicle travel. This includes transit and TCM actions as well as non-transportation actions such as changes in zoning and land use. Some areas have not accounted for the reduction in travel associated with these measures in their modelling efforts. "Off-model" calculations are permissible (40 CFR 51.452(a)(1)) in order to capture small effects that otherwise would not surface in the model runs.

2. It is extremely important that modelers should accurately estimate speed. Post-processing of speeds after traffic assignment using more facility specific speed-capacity relationships may be more realistic than use of the speeds derived from the assignment. Since speed increases from very low speeds tend to reduce estimated NOx emissions (See the NOx curve attached), make sure VMT in this range is disaggregated. In Delaware, the replacement of daily speed assumptions (from a 24-hour assignment) with peak and off-peak speed distributions produced more accurate results, which substantially reduced the "build" NOx emissions.

3. Consideration should be given to the realism of the predicted speeds and volumes. Peak spreading under future congested conditions may be a more rational assumption than greatly reduced speeds during the peak. The EPA suggested that iterating congested assignment speeds back through trip distribution to achieve travel time consistency may result in shorter trips being estimated by the models under more congested condition. While techniques for performing this analysis are not currently available, the effect is currently under research sponsored by FHWA and EPA.

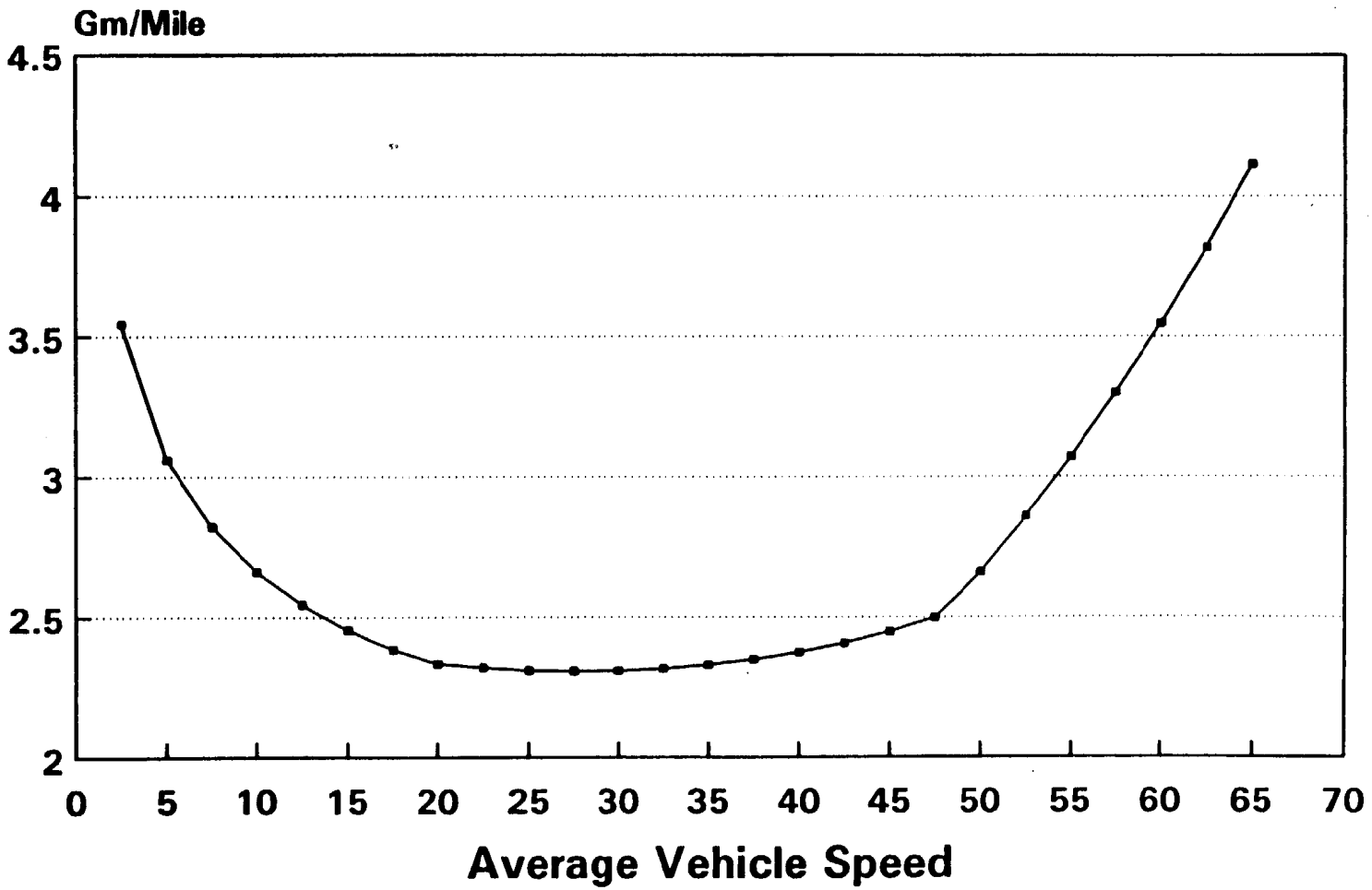
4. Adjustments and refinements to the modelling and other analysis must be carried out in the context of "good practice" (i.e., do not introduce modelling refinements that reduce NOx emissions for the build option and ignore equally valid refinements that would increase NOx emissions).

5. It is extremely important that the MPO and State DOT consult with and involve the State air quality agency and EPA in discussions and decisions about NOx modelling.

6. All modelling refinements should be carefully and fully documented.

NOx Emission Factors vs. Speed

(Year = 1995, Temp = 87.5F, Low Altitude)



12/10/93, J. Byun

ATTACHMENT 4

CURRENT NO_x-RELATED CONFORMITY ISSUES

The final transportation conformity rule became effective on December 27, 1993 and is already generating significant impact on the approval status of transportation plans, programs and projects. In particular, many areas are facing difficulty in meeting the conformity requirements for NO_x.

Table 1 summarizes the NO_x-related conformity periods and tests. The interim period ends and transitional period begins when a SIP revision is submitted which contains an emissions budget (or the deadline for submission passes). The NO_x transitional period starts with submission of the ozone Attainment Plan SIP revision due 11/15/94. (While a 15% Reduction SIP for ozone was due on 11/15/93, EPA only applied it to volatile organic compounds (VOC), not NOx. An area may be in different conformity periods at the same time for VOC and NO_x.) The NO_x control strategy begins when the ozone Attainment Plan SIP revision is approved by EPA.

Ozone nonattainment areas subject to transportation conformity determinations include areas classified as marginal and above by the Clean Air Act Amendments of 1990, as well as maintenance areas and nonclassifiable areas, i.e. transitional, submarginal,

Table 1 - Conformity periods and tests for NO_x in ozone nonattainment areas.

Period	Time Frame	NO_x Conformity Tests for Plans and TIPs
Interim	12/27/93 until Attainment Plan SIP revision submission (or deadline)	(a) build/no-build (b) reductions below 1990 emissions
Transitional	Attainment Plan SIP revision submission (or deadline) until EPA approval of the SIP revision	(a) build/no-build (b) reductions below 1990 emissions (c) emissions budget
Control Strategy	Attainment Plan SIP revision approval until redesignation to attainment by EPA	(a) emissions budget
Maintenance	Twenty year period following attainment redesignation	(a) emissions budget

and incomplete data areas. Under the rule, all of these areas are subject to the NO_x tests.

NO_x conformity demonstrations are particularly challenging during the interim and transitional periods. Many areas are experiencing difficulty in meeting the "build/no-build" test. These tests are intentionally stringent to ensure transportation plans and TIPs will contribute to air quality improvement prior to the approval of a control strategy. During the interim and the transitional periods, areas must analyze emissions and pass a build/no build test for several different years, i.e. first milestone year, attainment year (or at least 5 years beyond the first milestone year if the milestone and attainment years are the same), the last year of the transportation plan's forecast period, and additional years as necessary to allow no more than a maximum of 10 years between any analysis years. The NO_x build/nobuild test must be passed for all of these years to enable a conformity determination, in accordance with EPA's rule.

In many cases, the emissions budget test will be easier to meet than the build/no build test. Therefore, it is advantageous that the ozone Attainment Plan SIP revision be expeditiously submitted and approved to remove the requirement to perform the build/no build test.

Among the issues raised to date:

- FHWA/FTA were unable to issue a joint conformity determination under the final conformity rule for the **Delaware** counties of New Castle and Kent. This decision was announced in a January 18, 1994 letter from the FHWA Region 3 Administrator and was reported in the January 28, 1994 AASHTO Journal. The emissions analysis failed the NO_x build/no-build test for 1996 and 1999. The problem is exacerbated by the status of Delaware's 15% VOC Reduction SIP which was due on 11/15/93. Because Delaware's SIP was found incomplete by EPA, no new plans and programs can be found to conform after May 15, 1994.

- **Victoria, Texas** is an "incomplete data" ozone nonattainment area which is required to demonstrate conformity under the final transportation conformity rule. The area must complete the process by May 1, 1994 to participate in the Texas 1994 funding process. Because of some confusion, the conformity requirement took the area by surprise. Although the conformity analysis is currently being performed, officials from the area are concerned that they will fail the NO_x test.

- All ten 1993 urban transportation programs in **Ohio** were found to conform under the Interim Phase I conformity requirements. Subsequent analysis has shown that only two of these programs would have passed the Interim Phase II

requirements of the final conformity rule; the remaining areas would have failed the NO_x build/no-build test. For example, the emissions analysis for Akron predicts a 35% reduction in NO_x by 1997 with respect to the 1990 baseline yet would fail the NO_x build/no-build test for 1997 by 0.2%. Governor G. Voinovich expressed his concern over the next round of conformity determinations in a January 15, 1994 letter to President Clinton.

These three scenarios demonstrate the range and magnitude of problems that arise in making conformity determinations for NO_x under the final transportation conformity rule. Based on comments from state and local agencies during nine recently conducted conformity workshops, we anticipate that additional areas will face difficulty meeting the final transportation conformity rule requirements on NO_x in the forthcoming round of plan and program conformity determinations. They may also face difficulties in meeting the test on the other pollutants as well.

ATTACHMENT 5

NO_x WAIVERS AND OTHER EPA ACTIONS AFFECTING NO_x CONFORMITY

Currently Available Actions

1. **NO_x Waivers:** Section 51.194 of the transportation conformity rule provides that the conformity provisions apply to NO_x in ozone areas "unless the [EPA] Administrator determines under section 182(f) of the CAA that additional reductions of NO_x would not contribute to attainment." If EPA approves a waiver, it would eliminate the need for performing all NO_x conformity tests, including the build/no build. EPA recently issued guidance for obtaining NO_x waivers under section 182(f); this guidance was forwarded from FHWA Headquarters to the Regional Air Quality Specialists on February 4, 1994. Waiver opportunities exist for ozone nonattainment areas which: redesignate to attainment status and have not implemented NO_x reduction strategies; or demonstrate through photochemical modeling that additional NO_x reductions in the area would not contribute to attainment. Both measures may require a significant commitment of manpower and/or financial resources. When appropriate, however, areas should pursue NO_x waivers expeditiously. EPA has six months to rule on NO_x waiver submissions.

   In particular, ozone nonattainment areas with complete monitoring data which meets the ozone standard are encouraged to expedite their attainment redesignation SIP revision submissions. NO_x waivers may be requested when submitting for attainment redesignation.

2. **SIP Submittals:** Once an area submits and EPA approves the transportation budget in the SIP, the build/no build test for NO_x is no longer required, and the area must simply conform to the budget. In many cases it may be easier for the transportation sector to demonstrate conformity to the SIP budget than to satisfy the build/no build test, and the budget is more meaningful to reaching attainment. **Therefore, areas should make every effort to expedite submission of an approvable SIP revision with a transportation budget, and to obtain EPA approval of that SIP budget.** FHWA and FTA will continue to encourage EPA to act expeditiously on SIP budget submissions.

Proposed Actions Being Pursued with EPA

1. **NO_x Waivers:** FHWA will urge EPA to carefully consider such waiver requests and grant them expeditiously where the area provides a good case for the waiver. Since EPA's recently-issued waiver guidance was written with primarily stationary sources in mind, FHWA will encourage EPA to review and modify as appropriate the application of this guidance to

transportation conformity. We have been informed that EPA is developing a process for granting NOx waivers ahead of formal redesignation and maintenance plan approval, in areas with ambient data showing that attainment has in fact been achieved. FHWA and FTA will continue discussions with EPA on the appropriate use of this waiver authority and giving expeditious consideration to waivers.

2. **Additional Proposed Actions:** In the future, FHWA will discuss additional proposals with EPA regarding NO_x conformity. For example, the General Conformity Rule provides de minimis emission levels for individual non-transportation Federal projects. FHWA and FTA will discuss with EPA the merits of applying de minimis emission increases to transportation conformity tests. We will also explore with EPA the possibility of relaxing the NO_x conformity test requirements for nonclassifiable (transitional, submarginal, and incomplete/no data) ozone nonattainment areas. Some proposals may require a formal amendment to the conformity regulation, and therefor could not be immediately available.

Attachment 6

FHWA HEADQUARTERS CONTACTS FOR FURTHER INFORMATION ON NOx

Conformity rule and NOx:	Kathy Laffey, HEP-41 Phone: (202) 366-2077
Transportation strategies to reduce NOx:	Jay R. Turner, HEP-41 Phone: (202) 366-2072
NOx issues related to transit:	Abbe Marner, TGM-22 Phone: (202) 366-0096
NOx - modelling:	John Byun, HEP-41 Phone: (202) 366-2204
Transportation modelling:	John Byun, HEP-41 Phone: (202) 366-2204 Patrick DeCorla-Souza, HEP-22 Phone: (202) 366-4076
Information on NOx trends and transportation contribution to NOx:	Jay R. Turner, HEP-41 Phone: (202) 366-2072
EPA waivers and other EPA policy options re: NOx:	Kathy Laffey, HEP-41 Phone: (202) 366-2076 Jay R. Turner, HEP-41 Phone: (202) 366-2072